Candidate style answers

Introduction to quantitative reasoning

Medium banded responses

Introduction

This resource has been produced by a senior member of the Core Maths examining team to offer teachers an insight into how the assessment objectives are applied. It has taken questions from the sample question paper and used them to illustrate how the questions might be answered and provide some commentary on what factors contribute to overall levels.

As these responses have not been through full moderation, they are banded to give an indication of the level of each response. Please note that this resource is provided for advice and guidance only and does not in any way constitute an indication of grade boundaries or endorsed answers.

The sample assessment material for these answers and commentary can be found on Teach Cambridge Core Maths - Core Maths A (MEI) Level 3 Certificate - H868 and Core Maths - Core Maths B (MEI) Level 3 Certificate - H869.

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Question 1 (a)

The table shows exchange rates displayed at a bank in England.

(a) How much will 200 Euros cost a customer in English pounds?

[3]

Sample answer for question 1 (a)

1.31 Euros = £1

$\frac{200}{1.31}$ = £152.6717557

Commentary on the answer

This answer uses the incorrect exchange rate for changing pounds to Euros but performs the correct calculation to do the conversion. The answer has not been rounded to the nearest 1p.

Question 1 (b)

(b) A watch is priced at $58.50 US dollars.

Calculate an estimate of the cost of the watch in English pounds.

Use the exchange rates in the table.

Show your calculations **and** any approximations you make.

[3]

Sample answer for question 1 (b)

£1 is about $2. The watch is about $60,

so about £120

Commentary on the answer

The approximation £1 ≈ $2 is very rough but it is in the acceptable range. The price of the watch has been sensibly rounded but there is no working to show how the final answer has been obtained, and it is wrong.

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Question 2

The Earth travels round the Sun once a year.

The average distance of the Earth from the Sun is 1.5×10^{11} m.

Assume that the Sun remains still and ignore the rotation of the Earth about its axis.

(a) What assumption must be made about the path of the Earth to estimate its average speed from the information given?

[1]

(b) Calculate an estimate the Earth's average speed.

Give your answer in **km h^{-1}**.

Give your answer to an appropriate degree of accuracy.

[5]

Sample answer for question 2

(a) No assumption given.

(b) Speed = $\frac{\text{Distance}}{\text{Time}} = \frac{1.5 \times 10^{11}}{365} =$ 410 958 904 metres per day

= 410 958.904 km per day

= 410 958.904 × 24 = 9 863 014 km/hr

Commentary on the answer

(a) No assumption has been given, so subsequent working in part (b) does not take into account that the Earth takes a roughly circular path.

(b) A correct method is used to find speed and the conversion from metres per day to km per day has been correctly calculated although no workings have accompanied the answer. The following errors have been made:

The distance of 1.5×10^{11} m used in the speed calculation is the radius of the circular path, not the distance travelled.

The method for changing from km per day to km per hour is wrong – the answer has more km being travelled in one hour than were travelled in one day. It is always helpful to show a method – where an answer is incorrect from a correct method it is possible to gain some marks.

The answer is rounded to the nearest km/h even though the average distance from the Earth to the Sun was given to two significant figures. It would not be reasonable to expect the answer to be accurate to 7 significant figures when it is based on figures that are much less accurate than this.

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Question 3 (a)

This question is based on the article in the **pre-release material**, **'**Caring for the elderly'. A clean copy of the pre-release material is provided as an Insert.

A home care worker takes a new job through an agency.
They travel to elderly people's homes to provide care for them.
They are with each client for either 15 minutes or half an hour.

Here is a summary of their first day at work:

Morning (am):
- 7am - set off to see first client
- journey to first client takes half an hour
- with first client for 15 minutes
- journey to second client takes half an hour
- with second client for 15 minutes
- arrive home at 12 noon having seen a total of six clients, two for 15 minutes each and four for half an hour each.

Afternoon (pm):

- 5pm - set off for evening visits
- journey to first client takes 20 minutes
- arrive home at 7pm, having seen a total of four clients for 15 minutes each.

(a) The agency pays the care worker £7.30 an hour for the time they are with clients.
The agency does **not** pay the care worker for any time travelling.

How much does the agency pay the care worker for their first day?

[2]

Sample answer for question 3 (a)

8 people for 15 mins = 120 mins = 2 hrs

and 4 for 30 mins = 2 hrs

4 × £7.30 = £29.20

Commentary on the answer

This answer correctly identifies the number of people seen for 30 mins but incorrectly identifies the number of people seen for 15 mins. Correct working is shown clearly, but the final answer is wrong due to the error in the number of people seen for 15 minutes.

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Question 3 (b) (i)

(b) Another agency pays home care workers for time with clients **and** time travelling between clients.

They do **not** pay for time travelling to or from home.

That agency pays £6.31 an hour.

(i) Which of these is the most appropriate estimate of the care worker's total time travelling to and from home on their first day at work?

Tick (ü) one box.

30 minutes	☐
50 minutes	☐
1 hour 40 minutes	☐
3 ½ hours	☐

[1]

Sample answer for question 3 (b) (i)

30 mins out plus return in the morning, 20 mins out plus a return in the evening means more than 50 mins, possibly double, so 1 hr 40 mins seems the best estimate.

Commentary on the answer

This question only requires a tick box selection, so above is an illustration of the process taken to arrive at the answer.

This answer is correct and correctly reasoned – it is just an estimate of the travelling time to and from home that is asked for.

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Question 3 (b) (ii)

(ii) Work out how much the second agency would pay the care worker for their first day at work.

Use your answer from **(b)(i)**.

[3]

Sample answer for question 3 (b) (ii)

7am to 12pm = 5 hrs, 5pm - 7pm = 2 hrs, 5 + 2 = 7 hrs in total

7 hrs less 1 hr 40 for travel = 5 hrs and 20 mins.

Total = £33.65

Commentary on the answer

This answer correctly works out time with clients and time travelling between clients by subtracting the time that the care worker was travelling to and from home, (from (b)(i)), from the total time she was away from home. The amount paid to the care worker is correct, but no workings have been shown.

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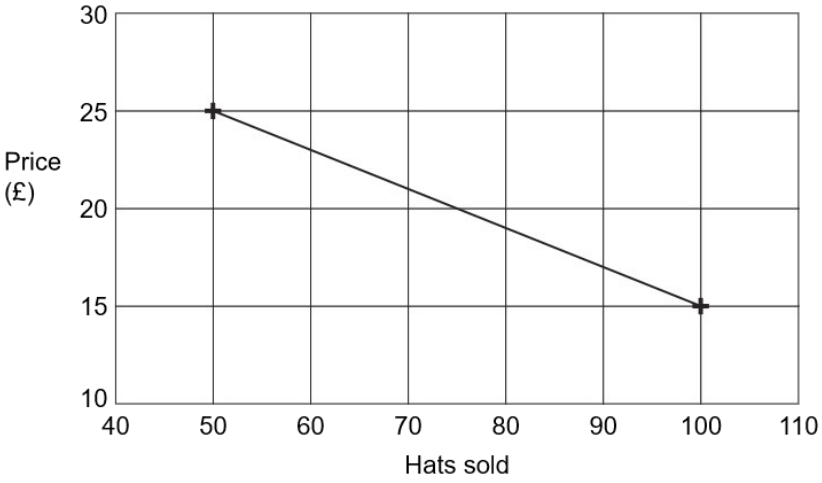
Question 4 (a)

Heidi sets up a business making hats.
She needs to decide how much to sell the hats for.
Each hat costs her £3 to make.
She can make up to 100 hats per week.

Heidi has done market research which suggests:

- she can sell 100 hats per week if she charges £15 for each hat
- she can only sell 50 hats per week if she charges £25 for each hat.

The graph shows the demand curve modelled as a straight line.



She uses this model and a spreadsheet to find the price for the hats that will give her the maximum profit.

The table opposite shows the spreadsheet she uses.

(a) Complete **column B** of the table by filling in the missing numbers.

	A	B	C	D
1	**Price (£)**	**Hats sold**	**Cost (£)**	**Profit (£)**
2	15	100	300	1200
3	16			
4	17		270	1260
5	18			
6	19			
7	20		225	1275
8	21			
9	22			
10	23		180	
11	24		165	
12	25	50	150	

[2]

Sample answer for question 4 (a)

	A	B	C	D
1	**Price (£)**	**Hats sold**	**Cost (£)**	**Profit (£)**
2	15	100	300	1200
3	16	95		
4	17	90	270	1260
5	18	85		
6	19	80		
7	20	75	225	1275
8	21	70		
9	22	65		
10	23	60	180	
11	24	55	165	
12	25	50	150	

Commentary on the answer

The correct numbers have been filled in for the number of hats sold, making use of the given start and end numbers and going down in equal steps. This is all that was required for part (a).

Question 4 (b)

(b) What formula should be in cell C2 so that it can be copied down the column to give the cost in each row?

[2]

Sample answer for question 4 (b)

B2*3

Commentary on the answer

This answer gives a correct formula, correctly expressed in terms of spreadsheet cell references, but it doesn't include the equals sign at the start.

Question 4 (c)

(c) What formula should be in cell D2 so that it can be copied down the column to give the profit in each row?

[2]

Sample answer for question 4 (c)

(A2*B2)-C2

Commentary on the answer

The brackets are not required in this answer, but it is an acceptable formula, correctly expressed in terms of spreadsheet cell references. Again, it doesn't include the equals sign at the start, but this would not be penalised again.

Question 4 (d)

(d) What price should Heidi sell the hats for to make the maximum profit?

The price of the hats needs to be a whole number of pounds.

[4]

Sample answer for question 4 (d)

	A	B	C	D
1	Price (£)	Hats sold	Cost (£)	Profit (£)
2	15	100	300	1200
3	16	95	48	1520
4	17	90	51	1530
5	18	85	54	1530
6	19	80	57	1520
7	20	75	60	1500
8	21	70	63	1470
9	22	65	66	1430
10	23	60	69	1380
11	24	55	72	1320
12	25	50	75	1250

£17 or £18

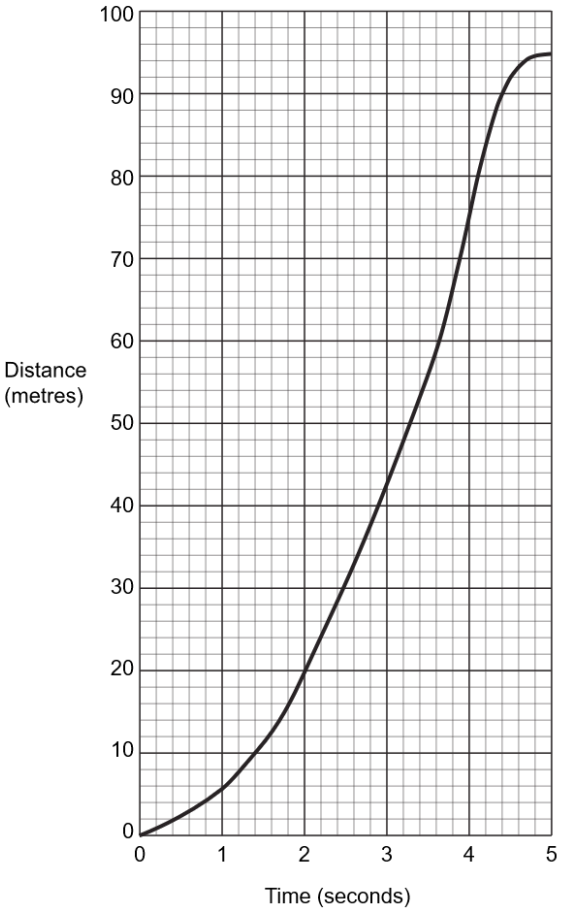
Commentary on the answer

In this answer the cost has been incorrectly calculated by multiplying the first column by the £3 cost of a hat rather than the second column. The figures calculated in the profit column are the revenues rather than the profits. Consequently, it is not possible to identify the optimum price.

Question 5 (a)

A cheetah is the fastest land animal.

a) The graph shows the motion of a cheetah over five seconds.



(i) At what time is the cheetah travelling the fastest? **[1]**

(ii) Calculate an estimate of the cheetah's maximum speed over these 5 seconds.

Use the graph. **[3]**

Sample answer for question 5 (a)

(i) 4 seconds

(ii) Speed = $\frac{\text{Distance}}{\text{Time}} = \frac{95}{5} = 19$ m/s

Commentary on the answer

(i) This answer correctly identifies the time when the cheetah is travelling fastest.

(ii) Average speed has been calculated rather than the maximum speed. The maximum speed occurs at the steepest part of the graph and so the correct solution would include estimating the gradient at this point, possibly by drawing a tangent to the curve and calculating the gradient of the line.

Question 5 (b)

(b) Two websites give the maximum speed of a cheetah.

- One website says that the maximum speed of a cheetah is 50 metres per second.
- The other website says that the maximum speed of a cheetah is 70 miles per hour.

Determine whether these two speeds are approximately the same.

Show your reasoning.

Use 5 miles $\approx$ 8 km.

[4]

Sample answer for question 5 (b)

70 ÷ 5 × 8 = 112 km per hour

112 km = 112 000 m

So, 112 000 metres per hr is the same as: 112 000 ÷ 60 = 1866.67 m/s

No, they are not the same.

Commentary on the answer

This answer uses a correct strategy of changing the speed in miles per hour to metres per second so that they can be compared. The correct conversion from miles per hour to km

per hour has been made but then the speed in metres per minute has been found, rather than metres per second (112 000 ÷ 60 ÷ 60 = 31.1 m/s).

Question 6 (a)

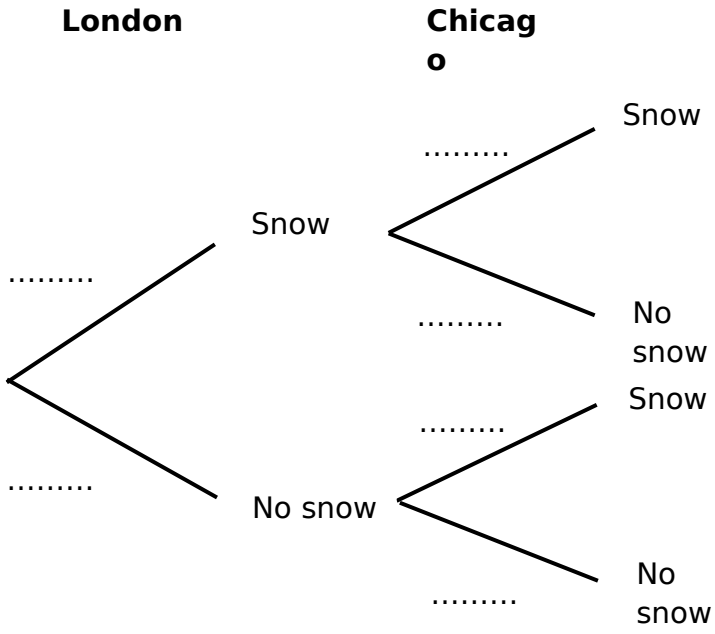
(a) A plane flies from London to Chicago.

The weather forecast for the day of the flight shows that:

- the probability of snow in London is 60%
- the probability of snow in Chicago is 80%.

Assume the weather in London and Chicago are independent of each other.

(i) Complete the tree diagram.



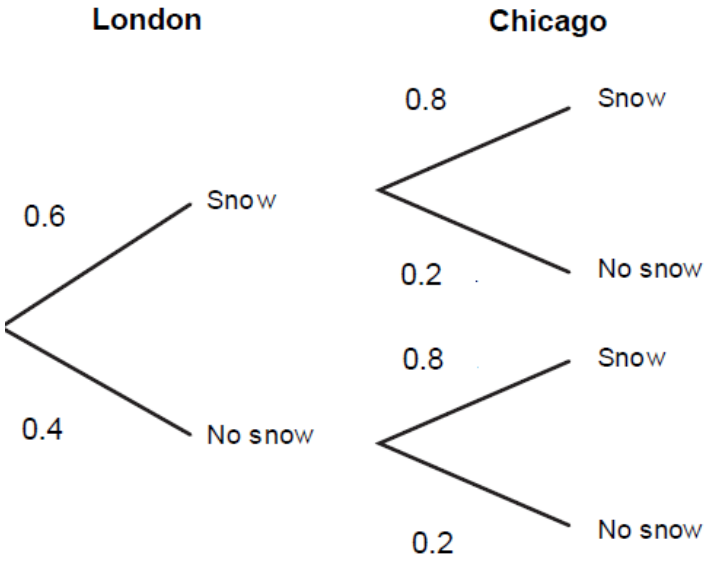
[3]

(ii) Calculate the probability that there will be snow in at least one of these two places on the day of the flight.

[2]

Sample answer for question 6 (a)

(i)



(ii)

		Chicago		
		Snow	No snow	Total
London	Snow	0.6 × 0.8 = 0.48	0.6 × 0.2 = 0.12	0.6
	No snow	0.4 × 0.8 = 0.32	0.4 × 0.2 = 0.08	0.4
	Total	0.8	0.2	1

0.4 + 0.2 = 0.6

Commentary on the answer

(i) The tree diagram is completed correctly.

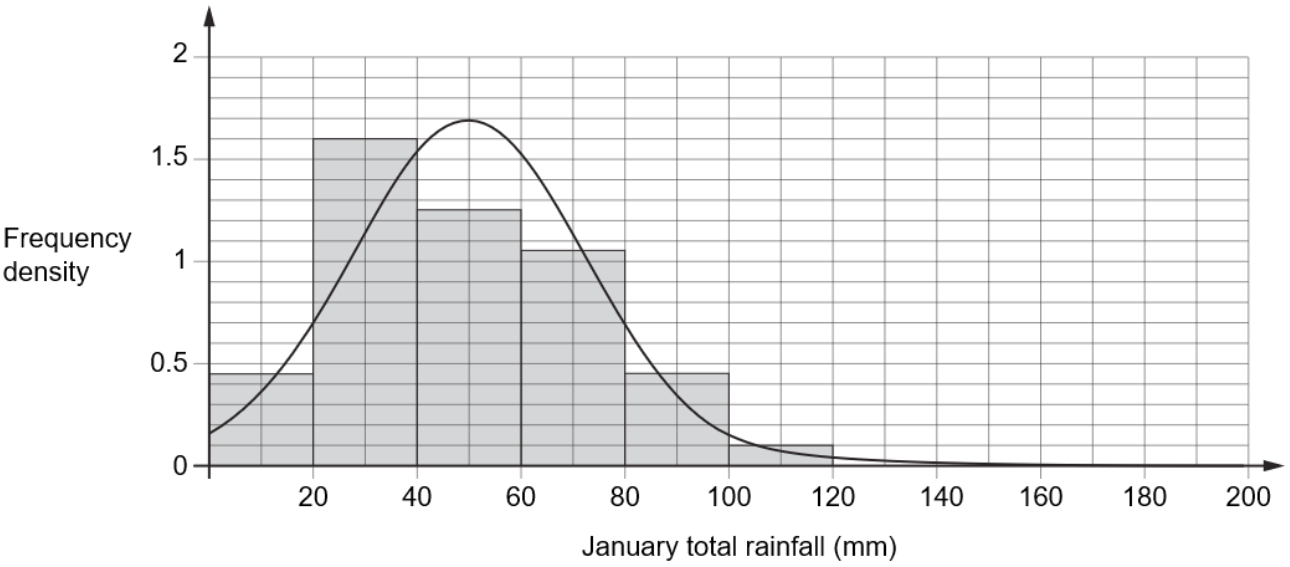
(ii) The individual probabilities have been calculated correctly in a two-way table. However, the calculation for the probability of snow in at least one of the two places has used incorrect values from the table.

Question 6 (b)

(b) The histogram shows the distribution of January rainfall near an English town for 98 years.

A Normal distribution has the same mean and standard deviation as the rainfall data.

The diagram shows part of this Normal curve.



(i) Use the Normal curve to work out an estimate of the mean of the rainfall data.

[1]

(ii) Use the Normal curve to calculate an estimate of the standard deviation of the rainfall data.

[2]

(iii) Give **two** reasons to reject the Normal distribution as a model for the rainfall data.

[2]

Sample answer for question 6 (b)

(i) The mean is about 50 mm

(ii) The standard deviation is about 140 – 50 = 90 mm.

(iii) The distribution of the rainfall data is skewed.

Commentary on the answer

(i) The answer has correctly identified the mean as being where the Normal curve has a maximum.

(ii) The answer for the standard deviation is incorrect – it has used the distance from the mean value to what appears to be the maximum value, but this is not the standard deviation.

(ii) The answer gives one correct reason for rejecting the Normal distribution as a model, but two reasons were asked for.

Question 7 (a) (i)

(a) The population of the world in 1960 was 3040 million.

The population of the world in 1975 was 4090 million.

Models A and B are two different models for the population growth.

(i) In model A the population grows by a constant **number** of people each year.

Show that the average increase from 1960 to 1975 is 70 million people per year.

[2]

Sample answer for question 7 (a) (i)

$$\frac{4090 - 3040}{15} = 70$$

Commentary on the answer

This answer correctly works out the constant annual increase in millions. It would be even better with a conclusion saying that this shows that the annual increase is 70 million.

Question 7 (a) (ii)

(ii) In model B the population grows by a constant **percentage** each year.

What constant annual percentage growth rate from 1960 to 1975 would result in the population increasing from 3040 million to 4090 million?

Show your working.

[3]

Sample answer for question 7 (a) (ii)

$$\frac{70}{3040} = 0.023 = 2.3\%$$

Commentary on the answer

This answer calculates what the percentage increase would be if the 1960 population increased by 70 million; this is not what was asked for. A correct answer would find the annual percentage increase, which compounded year on year would give 4090 million people in 1975.

Question 7 (a) (iii)

(iii) The population of the world in 2000 was 6090 million.

Determine which of the two models is better.

Show your reasoning.

[5]

Sample answer for question 7 (a) (iii)

Using model A, 25 × 70 = 1750 million extra since 1975, so 4090 + 1750 = 5840 million

Using model B, $3040 \times 1.023^{25} = 5367.406$

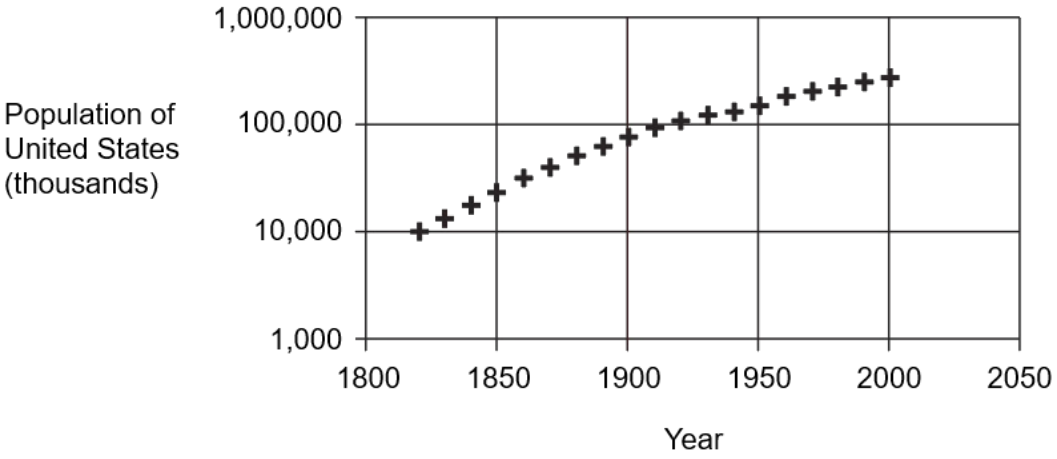
From these figures Model A looks closer to the actual figure of 6090.

Commentary on the answer

This answer uses model A correctly to work out an estimate of the population in the year 2000. However, for model B the incorrect percentage increase from part (ii) is used to work out an estimate of the population 25 years after 1960 instead of 25 years after 1975. The use of the incorrect percentage would still get some follow through marks.

Question 7 (b)

(b) The chart shows the population of the United States, in thousands, from 1820 to 2000.

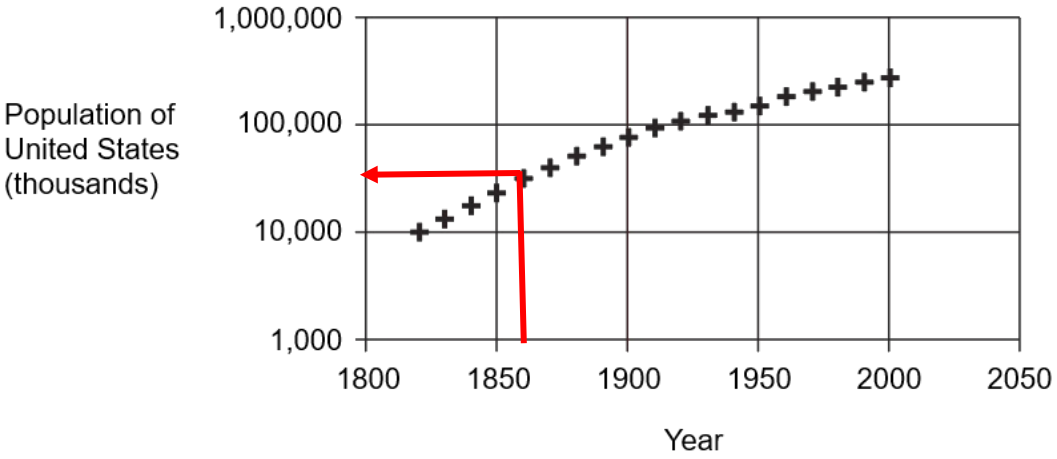


The vertical axis has a logarithmic scale.

What was the approximate population of the United States in 1860?

[3]

Sample answer for question 7 (b)



100 000 – 10 000 = 90 000

Half of this is 45 000

So, the population is 45 000 + 10 000 = 55 000

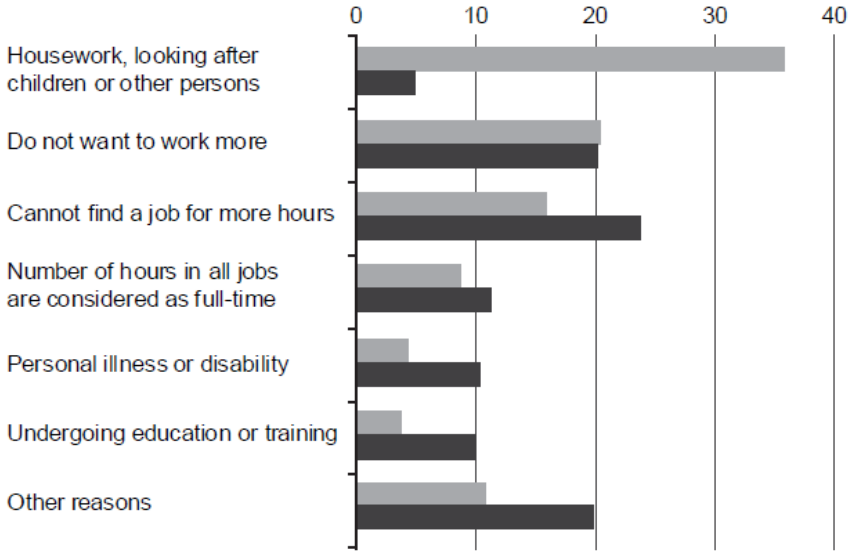
Commentary on the answer

This answer correctly identifies the point corresponding to 1860 and realises that it is approximately halfway along the scale between 10 000 and 100 000 but it does not appreciate that the scale is logarithmic. Moreover, it does not take into account that the vertical scale is in thousands, so 55 000 (thousands) is 55 million.

Question 8 (a)

Men and women in the European Union who work less than 30 hours per week were asked why they work less than 30 hours per week.

The chart shows the results of this survey in percentages.



(a) Suggest **one** way that the graph could be improved to show the information more clearly.

[1]

Sample answer for question 8 (a)

Put some more marks on the scale.

Commentary on the answer

It is not entirely clear what this answer means – it could be referring to more horizontal marks on the vertical axis or it might mean that there should be more vertical gridlines. It would be better if it stated precisely what should be done to the graph.

Question 8 (b)

(b) Each woman responding to this survey gave only one reason.

Show that the men responding to this survey also choose only one reason each.

[3]

Sample answer for question 8 (b)

It is possible for someone to give two reasons such as, looking after someone and they don’t want to work anymore, or illness and don’t want to work anymore. So, some men may have responded with more than one reason.

Commentary on the answer

This answer recognises that people may have more than one reason for not working more than 30 hours a week, but it does not take into account whether the survey allowed them to give more than one reason, so it does not answer the question. The data are given as percentages. If each person gave exactly one answer, the total for all bars should be 100%. If some people gave no answer, the total would be less than 100% but if some people gave more than one answer the total would be more than 100%.

Question 8 (c) (i)

(c) There are four times as many women as men working less than 30 hours per week in the European Union.

(i) Show that approximately 5% of people surveyed (men and women combined) gave the reason 'undergoing education or training'.

[2]

Sample answer for question 8 (c) (i)

The men's 10% is $\frac{1}{5}$ of the total percentage so 2% of the total.

The women's 5% is $\frac{4}{5}$ of the total percentage so 4% of the total.

Together this makes 6% of the total percentage.

Question 8 (c) (ii)

(ii) Find the corresponding percentage that gave the reason 'housework, looking after children or other persons'.

[2]

Sample answer for question 8 (c) (ii)

Women 36%, men 5%, so average is about 20%.

Commentary on the answer

This answer correctly reads the two values from the graphs but makes no attempt to take account of the different numbers of men and women in the population.

Question 9 (a)

A typical ant is about 5 mm long and weighs about 3 mg.

An actor has a height of about 2 m and weighs about 80 kg.

(a) How many times smaller is the length of the ant in comparison to the height of the actor?

[1]

Sample answer for question 9 (a)

2 m = 2000 mm

2000 ÷ 5 = 400

Commentary on the answer

This answer correctly converts metres to millimetres and works out the scale factor for length between the ant and the man.

Question 9 (b)

(b) A science fiction film script includes shrinking the actor to 5 mm tall.

As the actor shrinks, their weight is directly proportional to their volume.

Compare the weight of the 5 mm tall actor to the weight of the ant.

[4]

Sample answer for question 9 (b)

$80 \div 400 = 0.2$

The shrunk man will weigh 0.2 kg = 200 g.

$200 \div 3 \approx 67$

The man will weigh about 67 times as much as the ant.

Commentary on the answer

This answer does not use the information in the question that the weight will be directly proportional to the volume (and not the length). Consequently, the calculated weight of the shrunk man is wrong. At the end of the question when comparing weights, a weight in grams is compared to a weight in milligrams without putting them both into the same units.

Summary of updates

Version (Date of issue)	Section	Change
Version 1.0 (03/2023)		
Version 2.0 (11/2025)		Our Sample Assessment Materials have been updated as part of our accessibility principles and to reflect our live assessment materials. These resources are based on the Sample Assessment Materials, so some questions have been restructured or re-worded and the candidate style responses have been revised accordingly.

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